What’s in a Variable?

As illustrated in the previous worksheet, a variable is a name you create and use in your program to reference an object (i.e., the in-memory representation of a value, such as a number or a string). Python keeps track of the variables that you create and the objects that they reference using name spaces. The Variable explorer pane in Spyder provides one view of a name space. This view can be very useful when debugging a program. But it abstracts away an implementation detail that you sometimes need to understand to write programs that are both efficient and correct.

In this exercise, you will use PythonTutor, an on-line tool designed to help beginning programmers visualize how the Python shell executes a program. The goal is to develop a better understanding of how the shell creates and maintains name spaces and objects.

To get started, press the “Visualization” link in the artifacts section of the CTL web site. The webpage it takes you to shows the program that will be executed on the left and a ‘Print output’ box in the upper right. It shows a view of two areas in memory: an area, labeled “Frames,” in which the shell stores name spaces and an area, labeled “Objects,” in which the shell stores objects. A red arrow indicates the next statement that the shell will execute. (The shell does not execute comments.) A progress bar and four buttons appear beneath the program. These can be used to explore a visualization of an execution.

Press the “Forward” button to see how the visualization shows the effects of executing the first assignment (Step 1 of the execution).

Discuss what will change if you press the “Forward” button a second time. Then press the button to check your understanding (Step 2).

To simulate execution of the input expression at line 5, PythonTutor uses a dialog box that shows the prompt and contains a text box. You indicate the user input that you want PythonTutor to use for the visualization by typing it into the text box and then, instead of pressing the “enter”-key, you press the “Submit” button.

Continue to step slowly through the visualization.

Q: How does PythonTutor show a ‘reference’ to an object?

Q: Why do you think it might be important to explicitly show references?